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# AN EPIDEMIC OF ACUTE DIARRHEA APPROACHING IN SOME CASES A MILD DYSENTERY *

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The epidemic, which occurred around St. Anne de Bellevue, commenced in the second week of February, 1916, with cases of acute diarrhea. Many of these were not reported, the majority clearing up after the application of simple home remedies. The six cases observed by us readily yielded after purgation with castor oil and the institution of a proper diet. During March the cases reported were decidedly more severe. After the first week in April no new cases developed. A noticeable feature of the outbreak was that the majority of cases occurred among women students, and the worst cases among those whose resistance was low. Clinically, the cases may be outlined in the following subdivisions:

*Simple Diarrhea.*—These cases, as stated, occurred during February. The symptoms were few. There was usually a sudden onset, accompanied sometimes by vomiting. The stools averaged 6 to 8 a day. They were watery and foul-smelling with little mucus and no blood. No tenesmus and few cramps. Patients somewhat pale; complained of weakness and tiredness, and of impaired appetite. Pulse slightly accelerated, temperature normal throughout, urine and blood normal. These cases, when untreated, showed a tendency to recur at intervals of from 3 to 4 days, the attacks lasting in each case from 2 to 3 days.

*Dysenteric Diarrhea.*—In some cases this was of sudden onset, in others it was a gradual development from a pre-existing diarrhea. Symptoms were more urgent. About 10 stools a day, at first watery and brown, later becoming green, with considerable mucus and streaks of blood; severe cramps before defecation, little tenesmus. Patients were pale and slightly drawn of face, and complained of headache and drowsiness. Mouth foul and breath offensive; nausea and vomiting; abdomen slightly distended with gas and sensitive to pressure over course of large bowel. Pulse rapid; temperature 100-101. Urine and blood normal. These cases yielded as a rule to diet, bowel lavage, and intestinal antiseptics.

*Mild Dysentery.*—These cases were not reported at once and consequently were not treated for sometimes as long as 3 weeks. When first seen, the patients presented symptoms of an acute bowel infection,—flushed face, pinched eyes, dry mouth, offensive breath; abdomen distended and sensitive; frequent cramps and some tenesmus; 10 to 12 stools a day, green in color, with mucus and blood; pulse 100; temperature 102-103. The urine in one case showed albumin; the blood in 3 cases showed a polymorphonuclear leukocytosis (count—10,000).

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These cases cleared up as a rule in from 8 to 10 days under treatment similar to that for dysenteric diarrhea. One case ran a course similar to paratyphoid. Another developed jaundice 2 weeks after an attack of dysentery. Two cases recurred about 3 weeks after the initial attack and ran a similar, tho milder, course.

## TECHNIC

In the cases observed by us (A, B, C, D, E, and F), samples of stools were obtained before any treatment was instituted, sent immediately to the laboratory, and examined almost at once.

*Media.*—As an alternative to the Conradi-Drigalski medium, which we could not use for lack of crystal violet, 5 drops of a 5% solution of carbolic acid were added to the media employed on pouring the plates. In differentiating the cultures secured, the following media were employed: beef peptone agar and beef peptone gelatin made according to the standard methods;[1] litmus milk, a solution of litmus being sterilized separately and added in sufficient quantity to the milk tubes immediately before inoculation; and beef broth made with Liebig's extract. Dunham's solution for determination of indol-production was prepared as follows:

| | | |
|---|---|---|
| Witte's peptone | 10 gm. | filtered, tubed, and sterilized. |
| Sodium chlorid | 5 gm. | |
| Distilled water | 1000 c.c. | |

After inoculation the tubes were incubated at 37 C. for 6 days and then tested for indol by the Ehrlich method (which gives much more satisfactory results than can be obtained by the use of sulfuric acid and sodium nitrite). Two solutions were used:

| | |
|---|---|
| (a) P-dimethyl-amido-benzaldehyde .......... | 4 parts |
| Absolute alcohol ........................ | 380 parts |
| Concentrated HCl ...................... | 80 parts |
| (b) Saturated aqueous solution or potassium persulfate. | |

To 10 c.c. of the culture solution 5 c.c. of (a) are added and 5 c.c. of (b). The presence of indol is indicated by the appearance of a cherry-red color almost immediately. McConkey has obtained satisfactory results using 1 c.c. of each of the reagents (a) and (b).

*Sugar Reactions.*—For these the Smith fermentation tube was used. Peptone salt solution as used for the indol test was prepared and sterilized. The sugars were each made up in a 10% solution with distilled water and after intermittent sterilization, were added to the tubes immediately before inoculation, in such rates as would provide a resulting 1% sugar solution in peptone broth. The inoculations were made from a young peptone-broth culture of the organism.

In 5 of the 6 cases, mucus flakes were present, particularly in Sample D. Pieces of mucus were picked out with a platinum loop, shaken in sterile water, and smeared over the surface of the various media. Traces of the stools were also diluted in broth, plated, and incubated at 37 C., gelatin plates at room temperature. After 24 hours colonies thought worthy of investigation were isolated and streaked on beef peptone agar. Because of the close association of colon organisms with intestinal troubles and on account of the diagnosis of some of the cases as acute diarrhea, we subcultured not only those colonies which resembled the growth of B. dysenteriae, but also representatives of any other colonies which appeared to be common. Thus the cultural work resolved itself into a general bacteriologic examination of the stools; but the clinical aspects of the cases seemed sufficient warrant for the methods followed.

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[1] Standard Methods of Water Analysis, 1912, pp. 80, 124.

## RESULTS OF CULTURAL STUDIES

A.—The sample from this case yielded pure cultures of B. coli communior (Durham).

B.—Each of the cultures here obtained, one excepted, yielded B. coli-communis (Escherich). The exception, from an 18-hour-old agar culture, under the microscope appeared as a coccus varying to a short thick rod, 0.5 to 1 mm. long, sometimes showing bipolar staining with methylene blue, nonmotile, and gram-positive. Litmus milk,—no coagulation in 6 days, coagulation in 1 month. Beef peptone agar slant,— after 18 hours at 37 C., scanty spreading flat growth; medium unchanged. Litmus agar with mannite, maltose, or saccharose, acid. Glucose, lactose, saccharose, mannite, and maltose broths fermented with production of acid but no gas. Indol not produced.

C.—This case was a severer one. While strains of the colon type were isolated, several colonies which resembled B. dysenteriae were transferred to agar slants. Microscopically the organism was a short thick rod resembling the colon bacillus, the majority twice as long as broad, tho longer forms were present, average length 1.5 microns. In a 20-hour-old culture from beef peptone agar at 37 C. no motility was observed, but oscillations were noted resembling the action of the needle of a compass. This bacillus stained with the ordinary anilin dyes and was gram-negative. Agar plates,—20-hour-old colonies from 1 to 2 mm. in diameter, bluish by transmitted light, slightly raised.[2] Aesculin agar plates,—20-hour-old colonies 1 mm. in diameter, distinctly blue or transparent by transmitted light. Beef peptone agar,—after 24 hours moderate spreading growth, lustrous, flat, bluish by transmitted light; medium unchanged. Gelatin stab,—no liquefaction. Beef broth,—clouding, no pellicle, distinct watered-silk appearance, and, on shaking, a bluish iridescence noted on the side of the tube. Potato,—growth scant, spreading, glistening, the color of wheat straw. Litmus milk,—no coagulation; after 4 weeks reaction distinctly blue. Aesculin agar slant,—moderate growth, no black appearance. Hiss tube medium,—moderate growth, flat, iridescent, bluish by transmitted light. Litmus agar with mannite, maltose, or saccharose, acid. Glucose, mannite, lactose (+ —), maltose, and carbolized broth fermented with production of acid but no gas (saccharose fermented, but alkaline in reaction). Indol-positive.

D.—This case was also a severe one. Sample of stool contained much bloody mucus. Two varieties of organisms were common on all plates, one a type of indol-negative colon bacillus, and the other suggesting B. dysenteriae. The latter microscopically resembled the culture described from C. Eighteen hours' growth on beef peptone agar showed short stumpy rods from 1 to 1.5 microns long. In hanging drop the same oscillation was observed, and the same reactions with the various stains. Agar plates,—20-hour-old growth at 37 C. showed colonies 1 mm. in diameter, slightly raised, shiny, bluish by transmitted light. Aesculin agar plate,—20-hour-old growth at 37 C. showed colonies from 0.5 to 1 mm. in diameter, transparent to bluish by transmitted light. Beef peptone agar slant,—growth similar to the culture described from Case C. Litmus agar with mannite acid, with maltose and saccharose alkaline. Glucose, mannite, carbolized broth fermented with production of acid but no gas. Lactose, maltose, and saccharose fermented, but alkaline in reaction. Indol-negative.

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[2] Harrison and Vanderleck, Centralbl. f. Bakteriol., I, O., 1909, 51, p. 607.

E.—This was not a severe case, and all the organisms isolated proved to be one variety or another of the colon type.

F.—The sample in this case was green, mucous, and bloody. The plates of the various media showed 2 types of organisms, the one a strong indol-producer, conforming with the general tests for the colon type; the other differing in many respects from the organisms described as resembling B. dysenteriae. Its presence in some numbers, however, indicated the probability of its having had some relation to the case. Microscopically it appeared as a coccus from 0.5 to 0.75 mm. in diameter, as a diplococcus, and sometimes as masses resembling staphylococci. In the growth from a 20-hour-old culture on beef peptone agar incubated at 37 C. no motility was observed. It stained deeply with Loeffler's methylene blue, and was gram-positive. Beef peptone agar slant,—after 18 hours, moderate growth, discrete colonies, glistening. Beef broth,—moderate growth and clouding. Potato,—scant, barely perceptible growth. Litmus milk,—no coagulation; final reaction blue. Aesculin agar,—growth, but no black reaction. Litmus agar with mannite, maltose, or saccharose, acid. Glucose, mannite, lactose, maltose, and saccharose fermented with production of acid but no gas. Indol-negative.

## SUMMARY

Samples of stools from 6 patients were examined bacteriologically, with results indicating the cases to have been of bacillary origin. Sample A yielded apparently pure cultures of B. coli-communior (Durham). Sample B gave 2 types of organisms, B. coli-communis (Escherich), and an organism bearing certain resemblances to organisms of the dysentery group. Sample C showed strains of the colon group, and colonies agreeing in all cultural respects with B. dysenteriae (Flexner). Sample D gave indol-negative strains of the colon group, and colonies resembling closely B. dysenteriae Y of Hiss. Sample E yielded one variety or another of the colon type. Sample F gave 2 types of organisms, a colon type, and an organism that resembled B. dysenteriae in some of its cultural and biochemical reactions, but that morphologically was a gram-positive coccus or diplococcus.

The organisms isolated resembling the mannite-fermenting strains of B. dysenteriae may be classified according to their reactions on litmus sugar media, as follows:[3]

| Litmus Agar | **Shiga** | **Y (Hiss)** | **Flexner** | **Strong** | **Sample B** | **Sample C** | **Sample D** | **Sample F** |
|---|---|---|---|---|---|---|---|---|
| Mannite..... | — | + | + | + | + | + | + | + |
| Maltose...... | — | — | + | — | + | + | — | + |
| Saccharose... | — | — | — | + | + | — | — | + |

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[3] Kolle and Wassermann, Handb. d. pathogen. Mikroorganismen, 1909, p. 391, Flexner, System of Medicine, 1907, 2, p. 477. Besson, Practical Bacteriology, Microbiology, and Serum Therapy, 1913, p. 356. Remlinger and Dumas, Ann. de l'Inst. Pasteur, 1915, 29, p. 498. D'Herelle, Ann. de l'Inst. Pasteur, 1916, 30, p. 145.

The same organisms may be classified according to sugar reactions and indol-production as follows:

| Strain | Glucose | Lactose | Saccharose | Maltose | Mannite | Indol |
|---|---|---|---|---|---|---|
| Shiga.......... | ...... | ........ | − | − | − | − |
| Flexner........ | ...... | ........ | + | + | + | + |
| Y (Hiss)....... | ...... | ........ | − | − | + | − |
| Strong......... | ...... | ........ | − | + | + | |
| Sample B....... | +A | + A | + A | + A | + A | − |
| Sample C....... | + A | + Alk | + Alk | + A | + A | + |
| Sample D....... | + A | + Alk | + Alk | + Alk | + A | − |
| Sample F....... | + A | + A | + A | + A | + A | − |

A = acid; Alk = alkaline. Litmus used as indicator.

The occurrence in the same epidemic of both acute diarrhea and dysentery suggests the possibility that both are due to some variation of the same causal organism.

So far as we are aware this is the first time that organisms belonging to the Shiga group have been isolated as far north as Canada.

This and other studies indicate that we have a B.-dysenteriae group analogous to the B.-coli group.